

AMENDMENTS TO THE CLAIMS

1. (original) An array of electro-magnetically actuated MEMS devices, each device comprising:

a mirror having a reflective surface;

a gimbal structure for movably supporting said mirror about first and second axes;

a first coil pair on the mirror for causing selective movement of said mirror about the first axis in the presence of a magnetic field; and

a second coil pair on the mirror for causing selective movement of said mirror about the second axis in the presence of a magnetic field,

each of said first and second coil pairs substantially filling the area of the mirror covered by the reflective surface.

2. (original) The array of Claim 1 wherein the first and second coil pairs are superposed on said mirror and are separated by a dielectric layer.

3. (original) The array of Claim 1 wherein the coils of the first coil pair are wound in opposite directions from each other, and wherein the coils of the second coil pair are wound in opposite directions from each other.

4. (original) The array of Claim 1 wherein the coils of the first coil pair are positioned on different sides of said first axis, and wherein the coils of the second coil pair are positioned on different sides of said second axis.

5. (original) The array of Claim 1 wherein the magnetic field is applied by an array of magnets of alternating polarity.

6. (original) The array of Claim 5 wherein one or more of said magnets are associated with each one of said devices.

7. (original) The array of Claim 5 wherein said magnets are arranged in a checkerboard pattern of alternating north and south poles.

8. (original) The array of Claim 5 wherein said magnets include a first set of magnets having poles perpendicular to a plane on which said array of MEMS devices is arranged, and a second set of magnets having poles parallel to said plane, and wherein said magnets of said first set are arranged between magnets of said second set.

9. (original) The array of Claim 1 wherein each device further comprises a feedback mechanism for determining the angular deflection of a respective mirror about one of said axes.

10. (original) The array of Claim 9 wherein said feedback mechanism comprises an excitation coil fixed relative to the device and a detection circuit for sensing the relative proximity of one of said coils to said excitation coil.

11. (original) The array of Claim 1 wherein the reflective surface is on an opposite side of said mirror from said coil pairs.

12. (original) A magnetically actuated mirror array apparatus, comprising:

an array of electro-magnetically actuated MEMS devices, each device comprising: a mirror having a reflective surface; a gimbal structure for movably supporting said mirror about first and second axes; a first coil pair on the mirror for causing selective movement of said mirror about the first axis in the presence of a magnetic field; and a second coil pair on the mirror for causing selective movement of said mirror about the second axis in the presence of a magnetic field, each of said first

and second coil pairs substantially filling the area of the mirror covered by the reflective surface; and

an array of magnets positioned proximate said array of MEMS devices for applying the magnetic field, each magnet of said array being associated with one or more of said mirror devices.

13. (original) The apparatus of Claim 12 wherein said magnets are arranged in a checkerboard pattern of alternating north and south poles.

14. (original) The apparatus of Claim 12 wherein said magnets include a first set of magnets having poles perpendicular to a plane on which said array of MEMS devices is arranged, and a second set of magnets having poles parallel to said plane, and wherein said magnets of said first set are arranged between magnets of said second set.

15. (original) The apparatus of Claim 12 wherein each device further comprises a feedback mechanism for determining the angular deflection of a respective mirror about one of said axes .

16. (original) The apparatus of Claim 15 wherein said feedback mechanism comprises an excitation coil fixed relative to said device and a detection circuit for sensing the relative proximity of one of said coils to said excitation coil.

17. (original) The apparatus of Claim 12 wherein said reflective surface is on a side of said mirror opposite said coil pairs.

18. (currently amended) A magnetically actuated mirror array apparatus, comprising:

an array of mirror devices generally arranged in a plane, each mirror device comprising: a mirror; a gimbal structure for movably supporting said mirror about first

and second axes; and actuation coils for causing selective movement of said mirror about the first and second axes; and

an array of magnets generally arranged in a plane proximate and parallel to said plane of said mirror device array, with each magnet being associated with one or more of said mirror devices, wherein said magnets include a first set of magnets having poles perpendicular to the plane of said mirror device array, and a second set of magnets having poles parallel to said plane of said mirror device array, and wherein said magnets of said first set are arranged between magnets of said second set.

19. (original) The apparatus of Claim 18 wherein said magnets are arranged in a checkerboard pattern of alternating north and south poles.

20. (canceled)

21. (original) The apparatus of Claim 18 wherein each device further comprises a feedback mechanism for determining the angular deflection of a respective mirror about one of said axes.

22. (original) The apparatus of Claim 21 wherein said feedback mechanism comprises an excitation coil and a detection circuit for sensing the relative proximity of one of said coils to said excitation coil.

23. (original) A MEMS apparatus comprising:

an array of electromagnetically actuated MEMS devices arranged in rows on a substrate; and

an array of magnets positioned along a plane parallel to said substrate, said array of magnets including magnets along each row of devices having a pole direction parallel to said substrate, and magnets between each row of devices having a pole

direction perpendicular to said substrate such that said devices are within a magnetic field produced by said array of magnets.

24. (original) The apparatus of Claim 23 wherein said MEMS devices each comprise:

a mirror having a reflective surface;

a gimbal structure for movably supporting said mirror about first and second axes;

a first coil pair on the mirror for causing selective movement of said mirror about the first axis in the presence of the magnetic field; and

a second coil pair on the mirror for causing selective movement of said mirror about the second axis in the presence of the magnetic field,

each of said first and second coil pairs substantially filling the area of the mirror covered by the reflective surface.

25. (original) The apparatus of Claim 24 wherein said reflective surface is on a side of said mirror opposite said coil pairs.

26. (canceled)

27. (canceled)

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- 58. (canceled)
- 59. (original) An electro-magnetically actuated MEMS device, comprising:
 - a mirror having a reflective surface;
 - a gimbal structure for movably supporting said mirror about first and second axes;
 - a first coil pair on the mirror for causing selective movement of said mirror about the first axis in the presence of a magnetic field; and
 - a second coil pair on the mirror for causing selective movement of said mirror about the second axis in the presence of a magnetic field,
 - each of said first and second coil pairs substantially filling the area of the mirror covered by the reflective surface.

60. (original) The device of Claim 59 wherein the first and second coil pairs are superposed on said mirror and are separated by a dielectric layer.

61. (original) The device of Claim 59 wherein the coils of the first coil pair are wound in opposite directions from each other, and wherein the coils of the second coil pair are wound in opposite directions from each other.

62. (original) The device of Claim 59 wherein the coils of the first coil pair are positioned on different sides of said first axis, and wherein the coils of the second coil pair are positioned on different sides of said second axis.

63. (original) The device of Claim 59 wherein the magnetic field is applied by one or more external magnets.

64. (original) The device of Claim 59 further comprising a feedback mechanism for determining the angular deflection of the mirror about one of said axes.

65. (original) The device of Claim 64 wherein said feedback mechanism comprises an excitation coil fixed relative to the device and a detection circuit for sensing the relative proximity of one of said coils to said excitation coil.

66. (original) The device of Claim 59 wherein said reflective surface is on a side of said mirror opposite said coil pairs.

67. (canceled)

68. (canceled)

69. (currently amended) An electro-magnetically actuated MEMS mirror array apparatus, comprising:

(a) an array of mirror devices, each comprising:

a mirror having a reflective surface;

a gimbal frame for movably supporting said mirror about first and second axes;

a first coil on the mirror; and

a second coil on the gimbal frame, said first and second coils for causing selective movement of said mirror about the first and second axes in the presence of a magnetic field, said first coil substantially filling the area of the mirror covered by the reflective surface; and

(b) an array of magnets positioned proximate said devices for applying the magnetic field, each magnet of said array being associated with one or more of said mirror devices, wherein said magnets have poles parallel to a plane on which said array of mirror devices is arranged.

70. (canceled)

71. (canceled)

72. (canceled)

73. (original) The array of Claim 1 wherein the reflective surface and said coil pairs are on the same side of said mirror with the reflective surface generally covering said coil pairs.

74. (original) The apparatus of Claim 12 wherein the reflective surface and said coil pairs are on the same side of said mirror with the reflective surface generally covering said coil pairs.

75. (original) The apparatus of Claim 24 wherein the reflective surface and said coil pairs are on the same side of said mirror with the reflective surface generally covering said coil pairs.

76. (canceled)

77. (canceled)

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79. (canceled)

80. (canceled)

81. (canceled)

82. (canceled)

83. (original) The apparatus of Claim 69 wherein said first coil is on a side of said mirror opposite said reflective surface.

84. (original) The apparatus of Claim 69 wherein the reflective surface and said first coil is on the same side of said mirror with the reflective surface generally covering said second coil.

85. (new) An electro-magnetically actuated MEMS mirror array apparatus, comprising:

(a) an array of mirror devices, each comprising:

a mirror having a reflective surface;

a gimbal frame for movably supporting said mirror about first and second axes;

a first coil on the mirror; and

a second coil on the gimbal frame, said first and second coils for causing selective movement of said mirror about the first and second axes in the presence of a magnetic field, said first coil substantially filling the area of the mirror covered by the reflective surface; and

(b) an array of magnets positioned proximate said devices for applying the magnetic field, each magnet of said array being associated with one or more of said mirror devices, wherein said magnets include a first set of magnets having poles perpendicular to a plane on which said array of mirror devices is arranged, and a second set of magnets having poles parallel to said plane, and wherein said magnets of said first set are arranged between magnets of said second set.

86. (new) The apparatus of Claim 85 wherein said first coil is on a side of said mirror opposite said reflective surface.

87. (new) The apparatus of Claim 85 wherein the reflective surface and said first coil is on the same side of said mirror with the reflective surface generally covering said second coil.